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(12) # EUROPEAN PATENT APPLICATION

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(54) **Stack type heat exchanger.**

(57) A stack type heat exchanger which comprises a plurality of tubular elements (31) including a tank section (34) at least at one end, the tubular elements (31) being adapted to allow a heat exchange medium to pass through, a plurality of air paths interposed between one tubular element (31) and the next, each of the air paths being provided with a fin member (32), wherein each tubular element (31) comprises a pair of metal tray members (35) jointed at their peripheries with an inner plate (36) interposed therebetween, wherein each inner plate (36) is provided with projections (50) on its top surfaces and undersurfaces so that the flow of the medium is blocked by the projections (50) so as to enlarge the effective area for heat transfer between the medium and the tubular elements (31).

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Fig. 24 is a perspective view showing a known inner fin made of a corrugated plate.

Referring to Fig. 2 there are provided planar tubular elements 31 horizontally arranged in a stack, with the interposition of outer fins 32 between one tubular element and the next.

As best shown in Fig. 3 the tubular element 31 includes a passage 33 for passing a heat exchange medium through. Each tubular element 31 includes tanks 34 located at its opposite ends, the tanks 34 communicating with the medium passage 33 and being soldered one after another.

As shown in Fig. 1 the tubular element 31 is made up of two tray members 35, which are jointed with an inner plate 36 being interlocated. For explanation convenience one of the tray members 35 is referred to as a lower tray member and the other is as an upper tray member. Each tray member 35 has a concave bottom and the two members 35 are jointed with their concave bottoms being faced to each other as best shown in Fig. 5, so as to produce a fairly widened space 35a therebetween.

The tray member 35 includes raised sections 35b at opposite ends, the raised sections having apertures 35c which communicate with the apertures 36c of the inner plate 36. These apertures 35c and 36c are intended as medium passageways. The tray member 35 has rims 38 along the periphery thereof, the rims 38 being bent to constitute dew collecting troughs 39 as shown in Figs. 3 and 5. The rim 38 includes side walls 40 and a flat eave 41 as shown in Fig. 4. The reference numeral 42 denotes a guard wall. The tray member 35 is made of pressed aluminium.

The inner plate 36, made of aluminium, has edges 36a at opposite sides, the edges being extended into spaces 44 defined by the side walls 40 as best shown in Fig. 4. The inner plate 36 is provided with fins 37 so as to fill the medium passage 33 when the tray members 35 are jointed to each other. The fins 37 are made up of rectangular projections 50, which are arranged at equal intervals in straight lines perpendicular to the flow direction (H) of the medium and which are arranged in zigzag manners in the flow direction (H) of the medium as shown in Fig. 6 and 7. Because of the zigzag arrangements of the projections 50 the flow of the medium is blocked by one projection after another. Each projection has open ends in a direction perpendicular to the flow direction (H) of the medium and has a height equal to that of the adjacent one. The height of the projections 50 are determined so that they are fit in the space defined by the two tray members 35 as shown in Figs. 4 and 5. The fins 37 are used to reinforce the passage 33 and increase the efficiency of heat exchange.

The two tray members 35 are soldered to each other in the manner shown in Fig. 3, 4 and 5, thereby constituting a unitary body as the planar tubular element 31. In Fig. 1 the reference numeral 45 denotes draines through which the collected dew water is discharged.

The outer fin 32 is made of a corrugated aluminium plate and has a width equal to that of the tubular element 31. As referred to above the outer fins are fixedly sandwiched between one tubular element 31 and the next and also jointed to the flat eaves 41. Preferably the corrugated plate is provided with louvers.

In Fig. 2 the reference numerals 46 and 46′ denote side plates whereby the group of the outer fins 32 is framed. The medium is introduced into the heat exchange through an inlet header 47 and discharged through an outlet heater 47′. The inlet 47 is connected to an inlet pipe 48 and the outlet header 48′ is connected to an outlet pipe 48′.

In operation, the medium is introduced into the tubular element of the lowest row through the pipe 48 and flows throughout all the tubular elements, during which heat is exchanged between the medium and the air flowing in the direction (W) through the outer fins 32. The medium is discharged from the outlet header 47′ through the outlet pipe 48′ to a compressor (not shown). In the tubular elements 31 the flow of the medium is blocked by the projections 50 as described above, thereby agitating the medium. This increases the effective area of contact between the molecules of the medium and the projections 50, thereby leading to the efficient transfer of heat. Each tubular element is liable to elongating stresses under which the tanks 34 and the concave bottoms 33 tend to be expanded outward but the inner plate 36 are effective to protect them against a possible deformation and breakage. In addition, the joint between the tray members 35 is protected against disengagement. Furthermore, because of the plurality of the apertures 36c an undesirable stay of the medium is avoided, thereby protecting the tubular elements against a possible breakage. In addition the tubular element 31 is protected by the projections 50 of the inner fins 37 against a possible detrimental compression acting from above or below, or both. Thus the heat exchanger withstands a long period of use.

While heat exchange is going on between the air and the medium, water tends to come out of the moisture-contained air. The dew water is forced in the downstream direction along the top surfaces of the tubular elements 31 and finally falls into the troughs 39 as indicated by the arrow (A). The water is discharged out of the heat exchanger through the drains 45.

Another route of water coming from the dew is indicated by the arrow (B) in Fig. 4. This route of water comes partly from the outer fins 32 and partly from the overflow troughs 39. It is obstructed by the edges 36a of the inner plates 36 from dropping and is guided for discharge out of the heat exchanger. In this way the tubular elements are kept free from the dew water, thereby preventing the water droplets from flying about together with the air. This obviates the commonly called "flash troubles" which inflict the people in the car.

The embodiment shown in Fig. 8 has modified projections 60, which are arranged with flat portions 36d being interposed between one projection and the next along with width of the inner plate 36.

The embodiment shown in Figs. 9 and 10 has further modified projections 70, which are semi-hexagonal unlike the above mentioned rectangular

undersurface of the inner plate (36), the first roof member (921) having an opening (921a) upstream of the flow of the medium and a second roof member (922) on the top surface of the inner plate (36), the second roof member (922) having an opening (922a) downstream of the flow of the medium.

7. A stack type heat exchanger according to claim 6, characterized in that the first guide wall (91) and the second guide wall (92) are arranged alternately along the width of the inner plate and are arranged in rows at given intervals along the length thereof.

8. A stack type heat exchanger according to claim 1, characterized in that the tubular elements (31) and the outer fins (32) are alternately stacked horizontally.

9. A stack type heat exchanger according to claim 8, characterized in that each of the tubular elements comprises a trough (39) provided at the air exit side of the periphery thereof.

10. A stack type heat exchanger according to claim 9, characterized in that the inner plate (36) extends into the trough (39) so as to guide a dew water out of the heat exchanger.

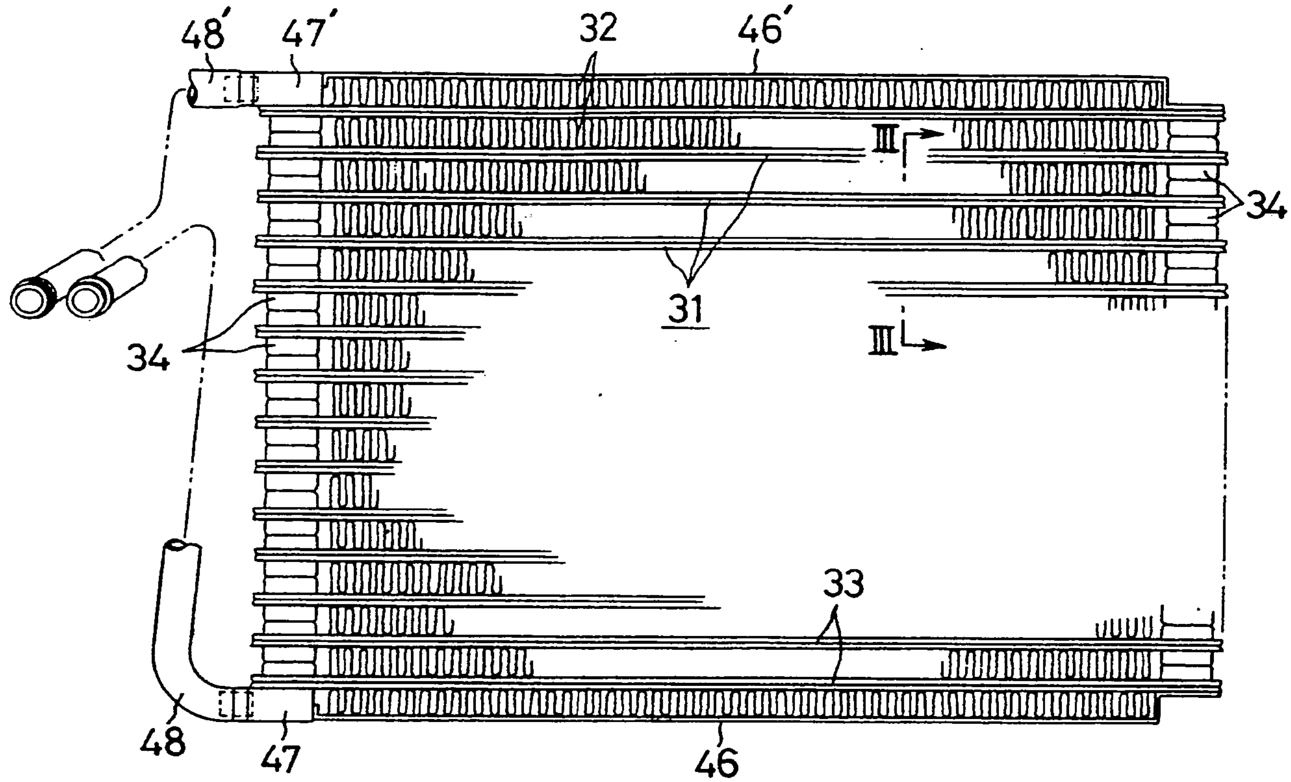
48'
47'
32
46'
III
34
31
34
III
33
48
47
46

FIG. 2

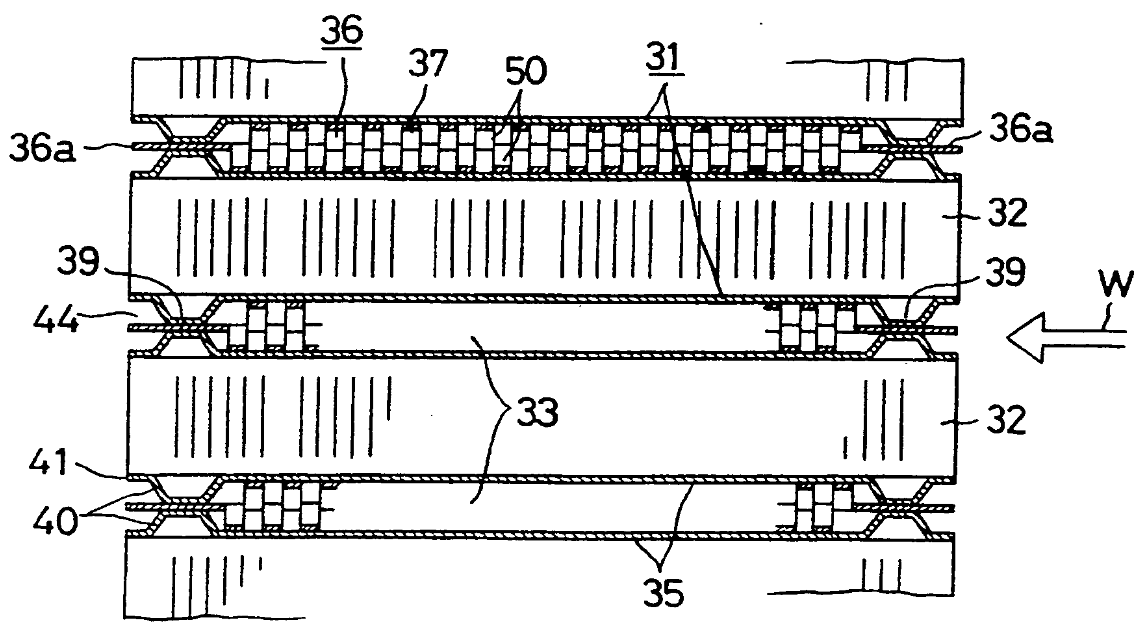
36
37
50
31
36a
36a
32
39
39
W
44
33
32
41
40
35

FIG. 3

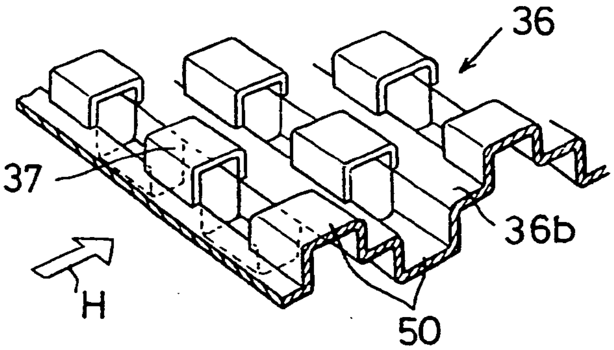

FIG. 6

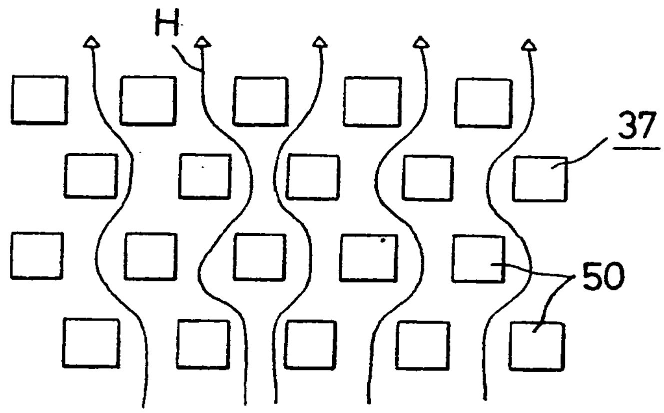

FIG. 7

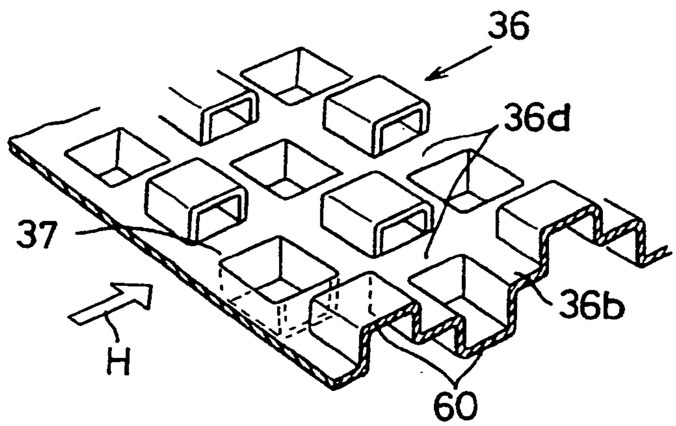

FIG. 8

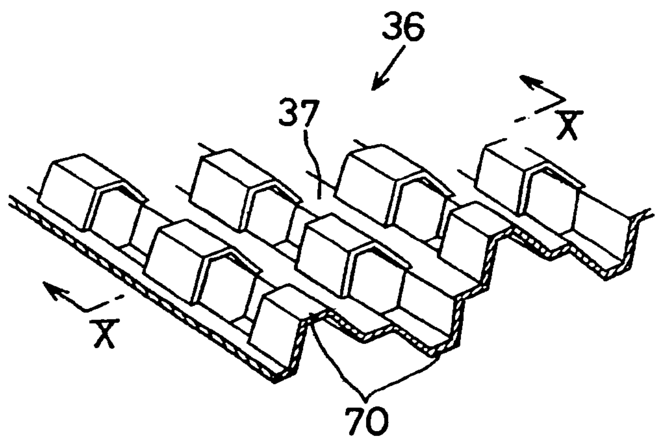

FIG. 9

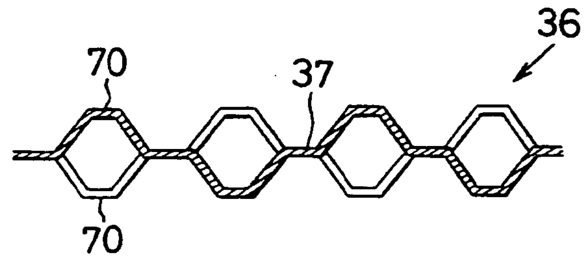

FIG. 10

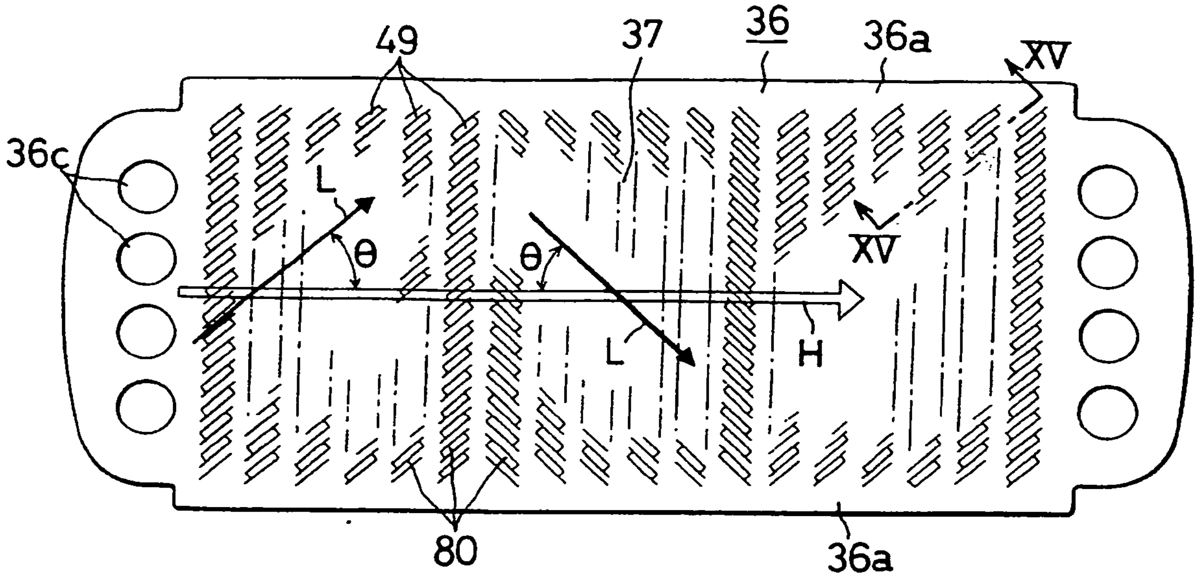

FIG. 14

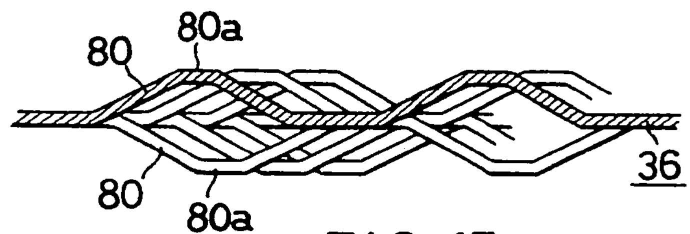

FIG. 15

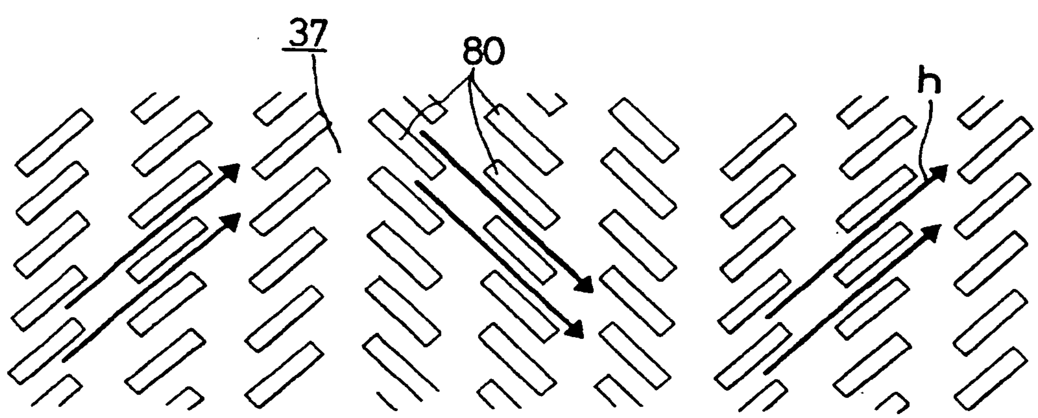

FIG. 16

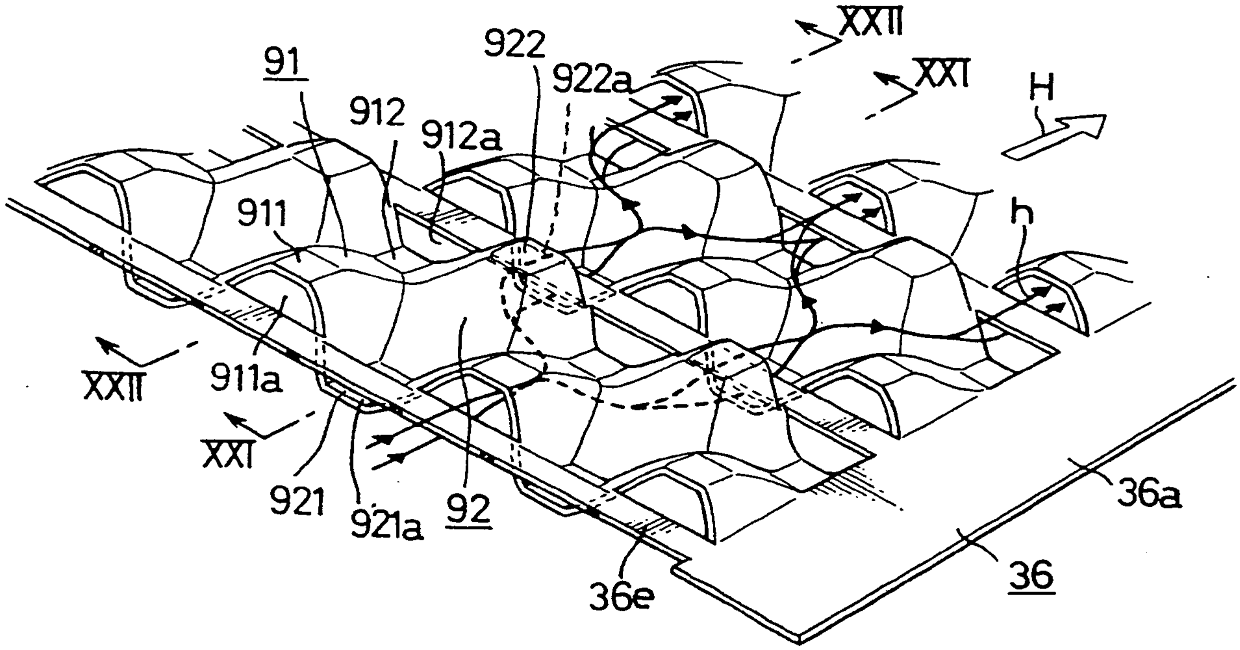

FIG. 20

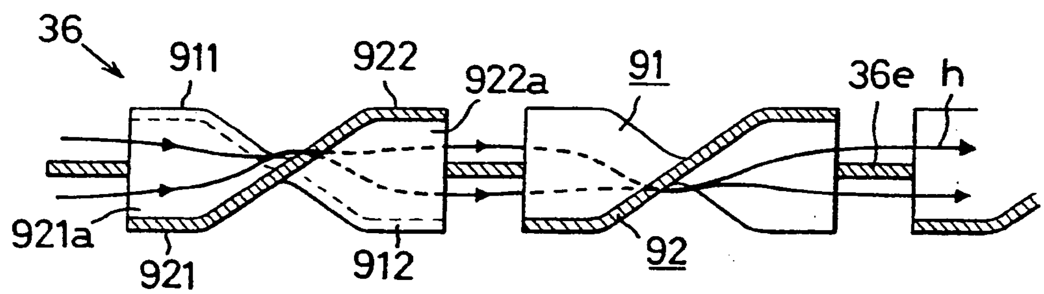

FIG. 21

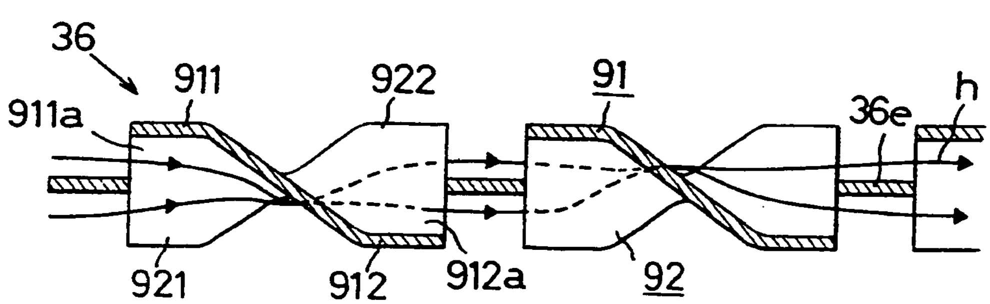

FIG. 22

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 87 30 1717

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	FR-A-1 521 595 (CHAUSSON) * Page 1, column 1, lines 8-18,27-35; column 2, lines 33-41; page 2, column 1, lines 1-17,45-56; column 2, lines 1-8; figures 1-7 *	1,2,8	F 28 D 1/02 F 28 F 3/08
Y		3,5	
Y	FR-A-2 230 952 (LÄNGERER & REICH) * Figures 3,6 *	3	
Y	FR-A-2 538 094 (GENERAL MOTORS) * Figure 4 *	5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
X	US-A-3 768 149 (SWANEY) * Abstract; column 2, lines 36-64; figures 1-4 *	1,2,8	F 28 D F 28 F
A	FR-A-2 298 075 (BORG-WARMER) * Figures 9-11 *	4	
A	DE-B-1 074 063 (GEA-LUFTKÜHLER) * Figures *		
P,X	DE-A-3 536 325 (OKAMOTO et al.)	1,2,8, 9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	09-06-1987	HOERNELL, L.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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